CLAIMS

What is claimed is:

1. A combustor comprising:

a combustor liner enclosing a cool portion and a hot portion of the combustor;

a pre-mix, pre-evaporation chamber positioned within the combustor liner providing a cool portion having an inlet opening from the cool portion of the combustor, a hot portion having an outlet opening into the hot portion of the combustor, and a flange extending from an outer surface of the pre-mix, pre-evaporation chamber toward the combustor liner and separating the hot portion of the combustor from the cool portion of the combustor;

a fuel injector positioned adjacent the inlet opening for injecting liquid fuel into the pre-mix, pre-evaporation chamber through the inlet opening; and

an igniter positioned in the hot portion of the combustion chamber adjacent the outlet opening;

wherein the liquid fuel injected into the pre-mix, pre-evaporation chamber from the injector mixes with air entering the pre-mix, pre-evaporation chamber through the inlet opening and evaporates substantially completely to form a combustion mixture of air and fuel vapor before exiting the pre-mix, pre-evaporation chamber through the outlet opening;

and further wherein the combustion mixture is ignited and is substantially consumed in a non-sooting flame within a combustion zone adjacent the outlet opening to produce a hot exhaust stream.

2. A combustor according to claim 1 wherein:

the inlet opening comprises both an axial inlet opening and a plurality of radial inlet openings arranged around a periphery of the cool portion of the pre-mix, pre-evaporation chamber, the fuel injector being positioned adjacent the axial inlet opening.

3. A combustor according to claim 2 wherein:

the axial inlet opening is approximately centrally located in a rear face of the pre-mix, pre-evaporation chamber.

4. A combustor according to claim 2 wherein:

a ratio of the volume of air entering the pre-mix, pre-evaporation chamber from the axial inlet opening and the volume of air entering the pre-mix, pre-evaporation chamber through the radial inlet openings is between 1 and 3.

5. A combustor according to claim 1 wherein:

fuel entering the pre-mix, pre-evaporation chamber remains in the pre-mix, pre-evaporation chamber for an average residence time before exiting the pre-

mix, pre-evaporation chamber through the outlet opening, the average residence time being between 5 milliseconds and 20 milliseconds.

6. A combustor according to claim 1 wherein:

the combustion mixture exiting the outlet opening has an average exit velocity sufficient both to prevent flashback into the pre-mix, pre-evaporation chamber and to prevent blowout of the non-sooting flame in the combustion zone.

7. A combustor according to claim 6 wherein:

the average exit velocity is between 5 meters/second and 50 meters/second.

8. A combustor according to claim 1 wherein:

the outlet opening comprises a plurality of radial outlet openings around a periphery of the hot portion of the pre-mix, pre-evaporation chamber.

9. A combustor according to claim 8 wherein:

the outlet opening further comprises an axial opening located on a front face of the pre-mix, pre-evaporation chamber.

10. A combustor according to claim 1 wherein:

a ratio of a length of the cool portion of the pre-mix, pre-evaporation chamber and a length of the hot portion of the pre-mix, pre-evaporation chamber is between about 1 and 3.

11. A combustor according to claim 1 wherein:

a ratio of a length of the pre-mix, pre-evaporation chamber and a diameter of the pre-mix, pre-evaporation chamber is between about 1 and 5.

12. A combustor according to claim 1 wherein:

a ratio of a diameter of the combustion liner and a diameter of the pre-mix, pre-evaporation chamber is between about 2 and 6.

13. A combustor according to claim 1 wherein:

a ratio of a volume of the cool portion of the pre-mix, pre-evaporation chamber and a volume of the hot portion of the pre-mix, pre-evaporation chamber is between about 0.2 and 3.

14. A combustor according to claim 1 wherein:

a ratio of a diameter of the cool portion of the pre-mix, pre-evaporation chamber and a diameter of the hot portion of the pre-mix, pre-evaporation chamber is between about 0.5 and 2.

15. A combustor according to claim 1 further comprising:

a cool air inlet adjacent the hot portion of the combustor and

an air channel extending along and adjacent a surface of the combustor liner from the cool air inlet to a preheated air inlet into the cool portion of the combustor, whereby air entering the cool air inlet is preheated by thermal energy from the combustor liner before entering the cool portion of the combustor.

16. A combustor according to claim 15 wherein:

a temperature difference between air entering the cool air inlet and preheated air entering the cool portion of the combustor is at least 100°C.

17. A combustor according to claim 16 wherein:

a temperature difference between air entering the cool air inlet and preheated air entering the cool portion of the combustor is at least 250°C.

18. A combustor according to claim 15 further comprising:

a dilution air inlet, the dilution air inlet being fluidly connected to the cool air inlet and located in a portion of the combustor liner surrounding the hot portion of the combustor for introducing air into the hot exhaust stream.

19. A combustor according to claim 18 wherein:

the dilution air inlet further comprises a plurality of radial dilution air openings arranged around a peripheral portion of the combustion liner.

20. A fuel processor of the type having a reformer operable for converting a hydrogen-containing fuel to a H_2-containing reformate.

a clean-up reactor in fluid communication with the reformer and operable for reducing carbon monoxide levels of the reformate, and

a combustor in fluid communication with at least one of the reformer and the clean-up reactor, the combustor comprising:

a combustor liner enclosing a cool portion and a hot portion of the combustor;

a pre-mix, pre-evaporation chamber positioned within the combustor liner providing a cool portion having an inlet opening from the cool portion of the combustor, a hot portion having an outlet opening into the hot portion of the combustor, and a flange extending from an outer surface of the pre-mix, pre-evaporation chamber toward the combustor liner and separating the hot portion of the combustor from the cool portion of the combustor;

a fuel injector positioned adjacent the inlet opening for injecting liquid fuel into the pre-mix, pre-evaporation chamber wherein the liquid fuel is evaporated in air to produce a combustion mixture; and

an igniter positioned in the hot portion of the combustor adjacent the outlet opening for igniting the combustion mixture;

the combustor being operable to ignite and substantially consume the combustion mixture in a non-sooting flame within a combustion zone in the hot portion of the combustor adjacent the outlet opening to produce a hot

exhaust stream for increasing the temperature of at least one of the reformer, the shift reactor and the preferential oxidation reactor.